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Pet Ownership and Psychosocial Factors in Adults Aged 40 Years and Over: Results of a Large Nationally Representative Longitudinal Survey

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Abstract: Thus far, few cross-sectional studies have investigated the association between pet ownership and psychosocial factors. As longitudinal studies on this topic are mostly lacking, this study aimed to analyze the association between pet ownership and psychosocial factors (in terms of depressive symptoms, loneliness, social isolation, and life satisfaction) using a longitudinal approach. The data used were taken from the German Ageing Survey (DEAS), a nationally representative sample of community-dwelling middle-aged and older adults (n = 12,438 observations). Two waves were used (year 2014 and year 2017). Validated multi-item scales were used to measure psychosocial factors. Linear fixed effects (FE) regressions were performed. In summary, only a few significant longitudinal associations were detected in regression analyses. No associations between general pet ownership and psychosocial factors were found. However, cat ownership was significantly longitudinally associated with increases in loneliness levels among the total sample and men. Cat ownership was also significantly longitudinally associated with increases in social isolation levels among men. Among women, dog ownership was significantly longitudinally associated with decreases in life satisfaction. This study reveals some associations between pet ownership and unfavorable psychosocial factors longitudinally. These associations were only significant for subgroups (cat vs. dog ownership and females vs. males).

Keywords: pet ownership; dog ownership; cat ownership; depressive symptoms; loneliness; social isolation; life satisfaction

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1. Introduction

The ownership of animals started thousands of years ago and it has evolved immensely through time. For instance, the relationship between an owner and an animal completely changed considering the use of the animal. In former times, animals used to be a source of food, labor, force, or a way of transportation. Nowadays, this traditional use of animals has become more minor, especially in developed countries [1].

The word ownership implies having full responsibility for and rights over something or someone. Nowadays, this indicates that someone is responsible for the survival and well-being of the pet; commonly, this manifests without attaining the previously named 'benefits' from this possession. Ownership includes time-consuming caregiving tasks and the financial burden as well as a potential health hazard associated with transmitted diseases or allergic reactions [2,3]. The companion animal multisectoral interprofessional and interdisciplinary strategic think tank on zoonoses (CALLISTO) states that the responsible treatment of pets should be based on the fact that animals have intrinsic value and they are sentient beings dependent on humans to stay healthy and well. Therefore, the duty of responsible pet ownership includes not only the minimization of risks to other animals, humans, and the environment but also the provision of appropriate care for the animal [4].

Nonetheless, a nationally representative study found that almost half of German households (47%) have at least one pet. Cats are the number one pet, being present in 26% of German households, whereas 21% of German households include a dog [5].

It appears to be plausible that pet ownership is more than a potential burden of responsibility. Instead, living with a pet has many benefits. Pet ownership is a way of expressing one's personality by having exotic animals to show peculiarity or providing a home to poisonous snakes to show bravery and independence [1]. However, according to Scoresby et al., for most people, the benefit of being a pet owner lies in the relationship with the animal, as it is not only a companion but a family member and thus an essential part of everyday life for many [6]. Accordingly, the word ownership in this context no longer implies power and control over the other living beings; rather, it refers to a peaceful coexistence from which both sides benefit.

Multiple studies have shown that pets increase the physical health of their caregivers. For example, prior research found that dog walking has a positive influence on overall physical activity levels [7] and that mild and moderate exercise was higher in pet owners, especially dog owners, compared to individuals living without pets [8]. Friedmann et al. found that pet ownership was longitudinally associated with favorable physical outcomes such as cardiorespiratory fitness, lower body strength, and overall physical performance when compared to individuals not living with a pet [9].

Besides positive effects on physical health, multiple studies focused on the psychosocial benefits attained by pet ownership. Various studies investigated the effect pet ownership has on *depressive symptoms* within the caregiver. Although not statistically significant, Samar Kishor Chakma et al. found pet owners to be 41% less likely to be depressed compared to non-pet owners [10]. This contrasts with several cross-sectional studies as Mueller et al., Parslow et al., and Enmarker et al. found an association between pet ownership and more severe depressive symptoms [11–13].

Nevertheless, other studies found no significant association between pet ownership and depressive symptoms [8,14,15]. Another study found quite varying results depending on whether the pet was a dog or a cat. It found that cat ownership was significantly associated with higher depression scores compared to non-ownership even though dog ownership was not significantly associated with changes in the depression score [13]. All the previously mentioned studies investigating the association between pet ownership and depression had a cross-sectional study design. This makes it difficult to assess whether pet ownership was accountable for a change in the depression rate within the analyzed population or if depression led to the adoption of a pet animal or the decision not to adopt a pet. There are only a few longitudinal studies concerning this association. These found no difference between pet ownership and non-ownership regarding depression.

Loneliness is another important psychosocial factor that might be influenced by pet ownership. Pikhartova et al. found in a cross-sectional study that female pet owners were significantly more likely to report loneliness at the time of data collection compared to female non-owners [16]. Longitudinally, reported loneliness throughout all waves as well as moving out of loneliness in between waves was positively associated with pet ownership in the last wave compared to when no loneliness was reported. The study used the short form of the Revised University of California, Los Angeles (UCLA), loneliness scale to assess loneliness. However, it is to be noted that the results of Pikhartova et al. were only significant for women [16]. Pikhartova et al. state that pet ownership may be a response to loneliness or serve as a protection for those who already recovered from loneliness [16].

Social isolation is a psychosocial variable closely linked to loneliness. However, social isolation does not necessarily lead to feelings of loneliness and loneliness may occur within people who are not socially isolated. Therefore, these variables must be taken into account separately.

Taniguchi et al. found in a cross-sectional study that current and past pet ownership was significantly associated with less social isolation [17]. These associations were observed for cat ownership as well as dog ownership.

However, there is literature indicating that the level of social isolation differs depending on the type of pet someone owns. Hajek and König found in a cross-sectional study of wave five of the DEAS study that dog owners without a partner were less socially isolated compared to individuals not living with a dog (and without a partner). However, there was no significant difference found in cat owners without a partner compared to non-owners without a partner [18]. They restricted their calculations to the subgroup of individuals aged 65 years and above who live without a partner. Yet, thus far, there is a complete lack of longitudinal studies examining the association between pet ownership and social isolation.

Life satisfaction is a psychosocial factor of increasingly acknowledged importance. According to a recent cross-sectional study, overall life satisfaction is higher in pet owners compared to non-owners. To be precise, Kim and Chun found that cat and dog ownership were positively associated with higher life satisfaction (with no significant difference between dog versus cat ownership). The study included 42,687 Seoul-based Koreans aged 15 years and older, using questions derived from the Personal Wellbeing Index-Adult (PWI-A) [19]. However, having both cats and dogs was associated with higher levels of life satisfaction compared to having either cats or dogs. Moreover, having only one cat or one dog was associated with more life satisfaction compared to having either multiple cats or multiple dogs [19].

In summary, the results of the few studies investigating the association between pet ownership and psychosocial factors are very heterogeneous. Moreover, previous research was mainly restricted by using cross-sectional data—which are prone to bias. However, the cross-sectional study design raises the question of whether individuals adopt a pet in order to cope with psychosocial challenges such as loneliness or increased depressive symptoms or if the adoption of a pet has a main effect on psychosocial factors [20]. Thus, it is difficult to clarify the directionality by using cross-sectional data.

In light of the restricted knowledge (particularly studies based on longitudinal data), our aim was to analyze the association between pet ownership and psychosocial factors using a longitudinal approach and based on representative data. Regarding psychosocial factors, we refer to depressive symptoms, loneliness, perceived social isolation, and life satisfaction. This topic is of great importance since adverse psychosocial factors can increase the risk of mental and somatic disorders [21]. Additionally, beneficial psychosocial factors can contribute to longevity and successful aging [22].

Pet ownership may contribute positively to the psychosocial health of the caregiver as the attachment theory suggests intense relationships lead to emotional benefits and therefore positively affect psychosocial factors. Even though the attachment theory by John Bowlby originally refers to the relationship a child experiences with their mother, the theory can also be applied to the relationships between individuals in later life and their pets.

Beck and Madresh found that the relationship structure with pets is similar to the one with humans. Moreover, the same study found that a higher sense of security was experienced in the human–pet relationship compared to the relationship with the pet–owner's romantic partner [23]. This could be explained by the type of relationship a pet offers to its caregiver. The relationship is shaped by being uncomplicated and rewarding, which can lead to a consistent and relatively controllable sense of security. A secure relationship may buffer challenging life situations like a complex relationship with a partner or difficulties at work. The relationship could be especially significant for the elderly as a pet may help overcome spousal loss [24] and adapt to health deteriorations such as incident frailty [17].

In summary, in accordance with the attachment theory, this study hypothesizes that the acquisition of a pet is associated with beneficial psychosocial factors (i.e., decreases in depressive symptoms, lower loneliness levels, lower perceived social isolation levels, and higher life satisfaction).

2. Materials and Methods

2.1. Sample

The data used for this study come from the cross-sectional and longitudinal German Ageing Survey ("Deutscher Alterssurvey", DEAS), funded by the Federal Ministry for Family Affairs, Senior Citizens, Women, and Youth. The studied population consists of community-dwelling individuals living in Germany, aged 40 years and over. This nationwide representative survey covers a broad thematic spectrum including health and psychosocial variables as well as living conditions. The data are collected through a computer-assisted-personal-interview (CAPI) as well as a written questionnaire, completed by each participant. So far, there are seven waves available, starting in 1996 up to the most recent data collection in 2020/2021. Further details regarding the DEAS study are provided by Klaus et al. [25].

For this current study, longitudinal data from waves five and six (year 2014 and year 2017) were included. Prior waves and wave seven were excluded due to the absence of data concerning pet ownership. Wave five includes participants of previous waves (n = 4322) with a response rate of 61% as well as a new base sample (n = 6001) with a response rate of 25%. In total, wave five includes 10,323 participants. In contrast, wave six only includes participants of previous waves, leading to n = 6626 participants with a response rate of 63%.

For this study, only participants who provided data on the needed variables (i.e., pet ownership, depressive symptoms, social isolation, loneliness, and life satisfaction) over time were included, which resulted in n = 12,438 observations (which equaled 8205 individuals) in the analytical sample. Please see the Section 2.1.4 for further details.

Prior to participation in the survey, all individuals gave written informed consent. No ethical approval was required for the DEAS study, as the criteria for such a vote were not fulfilled (e.g., physical examination of individuals, risk of discomfort to participants, etc.) This was confirmed by the scientific advisory board of the German Ageing Survey prior to each wave.

2.1.1. Dependent Variables

The scales described in the following were recoded by DEAS from the original scales, as described in the Documentation of Variables [26]. All modifications and recoding to the validated scales were taken over unedited from DEAS for use in this study.

Loneliness was measured using the shortened 6-item De Jong Gierveld loneliness scale (Gierveld and Tilburg, 2006) originating from the original 11-item version [27]. Three items were recoded. Participants were asked to rate each item with a score ranging from 1 "strongly agree" to 4 "strongly disagree". Exemplary items included "I miss the pleasure of the company of others" and "I miss emotional security and warmth" [26]. By averaging the ratings of the (recoded) items, a score was developed (ranging from 1 to 4, with higher values reflecting higher loneliness levels). This tool has satisfactory psychometric properties [28]. In our study, Cronbach's alpha was 0.82 (McDonald's omega: 0.83) in wave five and Cronbach's alpha was 0.83 (McDonald's omega: 0.84) in wave six.

Perceived social isolation was assessed using a tool created by Bude and Lantermann [29]. It consists of four items, all of which were recoded by DEAS staff. Exemplary items included "I feel that I am left out" and "I feel excluded from society" [26]. Again, by averaging the ratings of the (recoded) items, a final score was computed (1 to 4, higher values indicating higher perceived social isolation). The scale resembles the mean of the values of the four items. Cronbach's alpha was 0.88 (McDonald's omega: 0.89) in wave five and Cronbach's alpha was 0.87 (McDonald's omega: 0.88) in wave six.

Life satisfaction was measured using the Satisfaction with Life Scale (SWLS) designed by Diener in 1985 [30]. The scale includes five items with possible ratings ranging from "strongly agree" (score 1) to "strongly disagree" (score 5). The scale—which ranges from 1 to 5—shows the mean of at least 3 ratings of the items, all items have been recoded by DEAS staff. Exemplary items are "I am satisfied with my life" and "So far I have gotten the most important things I want in life" [26]. A higher score represents higher life satisfaction.

Cronbach's alpha was 0.85 (McDonald's omega: 0.86) in wave five and Cronbach's alpha was 0.84 (McDonald's omega: 0.85) in wave six.

Depressive symptoms were measured with the Centre of Epidemiologic Studies Depression Scale (CES-D) created by Radloff in 1977 [31]. This scale measures the occurrence of depressive symptoms within the past week, using 15 items, 2 items were recoded. Possible ratings ranged from 1 = "rarely, or not at all" to 4 = "most of the time, or all of the time", being recoded to 0–3. Exemplary items included "I couldn't get myself to do anything" and "I felt depressed" [26]. By summing up the ratings, a final score was developed from 0 = no depressive symptoms to 45 = severe depressive symptoms. Cronbach's alpha was 0.86 (McDonald's omega: 0.87) in wave five and Cronbach's alpha was 0.86 (McDonald's omega 0.87) in wave six.

2.1.2. Independent Variable of Interest

Pet ownership was the key independent variable of this study. In order to quantify pet ownership, respondents were asked "do you have pets?" [no; yes]. If they answered with "yes", participants were further asked whether they owned (1) one or more cats, (2) one or more dogs, or (3) other pets than cats and dogs.

2.1.3. Covariates

In regression analysis, several time-varying socioeconomic covariates were adjusted for, including age, marital status (married and living together with spouse versus other (divorced; single; widowed; married and living separately from a spouse)), household income (measured as the overall net household income in Euro), and employment status (employed; retired; other: not employed).

Moreover, the analysis was adjusted for multiple lifestyle-related covariates: smoking behavior ("Yes, daily"; "Yes, occasionally"; "No, not anymore"; "I have never smoked"), alcohol intake ("daily"; "several times a week"; "once a week"; "one to three times a month"; "less often"; "never"), and the level of physical activity (six possible answers ranging from "daily" to "never").

Self-rated health (single-item measure: 1 = "very good"; 2 = "good"; 3 = "average"; 4 = "bad"; 5 = "very bad") and the number of self-reported illnesses (count score ranging from 0 to 11 chronic conditions: cardiac and circulatory disorders; bad circulation; joint, bone, spinal or back problems; respiratory problems, asthma, shortness of breath; stomach and intestinal problems; cancer; diabetes; gall bladder, liver or kidney problems; bladder problems; eye problems, vision impairment; ear problems, hearing problems) were considered as health-related covariates.

2.1.4. Statistical Analysis

For this longitudinal analysis, the change in pet ownership and its association with psychosocial variables was analyzed.

Our analytical strategy was as follows:

(1) The FE regressions were performed for a change in pet ownership, a change in dog ownership, and a change in cat ownership as the independent variable;

(2) In sensitivity analysis, cat and dog ownership was stratified by gender as well as age group (because the longitudinal association may vary depending on the age group and gender, as, for instance, Smolkovic et al. found that female owners are more attached to their pets [32]). The dependent variables for all analyses were the following psychosocial variables: depressive symptoms, loneliness, life satisfaction, and social isolation.

Change into pet ownership includes the transition between not living with any kind of pet in 2014 to living with a pet whether this is one or more dog/s, one or more cat/s., or other in 2017. Furthermore, it includes the transition between living with any kind of pet in 2014 to not living with a pet in 2017.

The same analyses were run for dog ownership. The transition into dog ownership was defined as individuals who did not live with any animals in wave five of data collection

and who lived with one or more dog/s but no other pets in wave six of data collection. Moreover, individuals who lived with one or more dog/s (but no other pet) and then lost it in between the waves were included.

The same analyses were run for cat ownership. The transition into cat ownership was defined as individuals who did not live with any animals in wave five of data collection and who lived with one or more cat/s but no other pets in wave six of data collection. Moreover, individuals who lived with one or more cat/s (but no other pet) and then lost it in between the waves were included.

Furthermore, the analyses concerning dog and cat ownership were stratified by gender and age to determine whether the relationship was specific for any of these groups. The gender of the respondent was ascertained in the DEAS study as part of the CAPI. The interviewer selected a female or male according to the name of the participant. In the case of uncertainties, the respondent was asked to state the gender [33,34]. For the stratification by age, the dataset was divided into individuals being younger than 65 years versus individuals being 65 years and above.

Linear fixed effects (FE) regressions were used to examine the associations of interest over time. FE regressions solely exploit changes within individuals over time (e.g., changes in pet ownership within an individual from wave five to wave six or changes in depressive symptoms within an individual from wave five to wave six). This also means that only such time-varying can be used as independent variables (such as self-rated health, which can change within individuals over time). However, time-constant factors such as gender or country of origin can be used to stratify the FE regression models. It should be noted that the exclusive focus on within variations is not a shortcoming of the FE approach. It merely reflects the reality that a specific segment of the population experiences changes in these factors. Further details regarding the FE approach can be found here [35,36].

Linear FE is specifically useful because it allows the identification of an average treatment effect on the treated under quite weak assumptions compared to pooled linear models and random effects (RE) models. More precisely, FE models allow for a systematic association between time-constant factors (both, observed, and unobserved) and explanatory variables, whereas pooled linear models or RE would produce inconsistent estimates in such a case [37,38]. The statistical significance was set with $p < 0.05$. In order to perform all analyses, Stata/MP 17.0 (StataCorp, College Station, TX, USA) was used.

3. Results

3.1. Sample Description

Sample characteristics are shown in Table 1. In our analytical sample, 12,438 observations were included. In the analytical sample, the average age was 65.4 years (SD: 11.0 years) and 50.3% were female. Furthermore, the average loneliness score was 1.8 (SD: 0.5). The average social isolation score was 1.6 (SD: 0.6). Moreover, the average life satisfaction score was 3.8 (SD: 0.7). Additionally, the average depressive symptoms score was 6.6 (SD: 5.9). Further details are provided in Table 1.

With regard to intraindividual transitions in pet ownership from wave five to wave six, in total, 270 participants lived with a pet in 2014 but did not live with a pet anymore in 2017. Moreover, 158 individuals did not live with a pet yet in 2014 but lived with a pet in 2017. Specifically, there were 60 individuals who lived with a dog (and no other pets) in 2014 but did not live with a dog (or other pets) in 2017. Additionally, 48 individuals did not live with a dog (or another pet) in 2014 but lived with a dog (and no other pet) in 2017. There were 106 individuals who lived with a cat (and no other pets) in 2014 who did not live with a cat (or other pets) in 2017 and 57 cat owners (who did not live with other pets) in 2017 who did not live with a cat (or other pets) in 2014. A table representing these changes in pet ownership can be found in Appendix A as Table A1.

Table 1. Sample characteristics for the analytical sample (pooled over both waves, n = 12,438).

Variables	N (%) Mean (SD)
Life satisfaction: Mean (SD)	3.8 (0.7)
Social isolation: Mean (SD)	1.6 (0.6)
Loneliness: Mean (SD)	1.8 (0.5)
Depressive symptoms: Mean (SD)	6.6 (5.9)
Count score: chronic illnesses: Mean (SD)	2.6 (1.9)
Smoking behavior (1–4): N (%)	
1. I smoke daily	1694 (13.0)
2. I smoke occasionally	488 (3.8)
3. I used to smoke, but not anymore	4855 (37.4)
4. I have never smoked	5958 (45.8)
Level of physical activity (1–6): N (%)	
1. Daily	1116 (8.6)
2. Several times a week	3601 (27.7)
3. Once a week	2396 (18.4)
4. Between 1–3 times per month	877 (6.7)
5. Less often	1477 (11.4)
6. Never	3528 (27.1)
Alcohol intake (1–6): N (%)	
1. Daily	1609 (12.4)
2. Several times a week	3215 (24.7)
3. Once a week	2055 (15.8)
4. Between 1–3 times per month	1592 (12.3)
5. Less often	3060 (23.5)
6. Never	1464 (11.3)
Self-rated health (1–5): Mean (SD)	2.5 (0.8)
Age: Mean (SD)	65.4 (11.0)
Employment status (1–3): N (%)	
1. Working	4544 (35.0)
2. Retired	7425 (57.1)
3. Other: Not employed	1026 (7.9)
Marital status: N (%)	
1. Married (civil union), living together	9087 (69.9)
2. Married (civil union), living separately	191 (1.5)
3. Divorced, (civil union annulled)	1296 (10.0)
4. Widowed	1539 (11.8)
5. Single	882 (6.8)
Gender: N (%)	
1. Male	6454 (49.7)
2. Female	6541 (50.3)
Education: N (%)	
1. low (ISCED 0–2)	731 (5.6)
2. medium (ISCED 3–4)	6592 (50.7)
3. high (ISCED 5–6)	5670 (43.6)

Notes: loneliness (score from 1–4 with higher values reflecting higher loneliness score); social isolation (score from 1–4 with higher values reflecting higher perceived social isolation); life satisfaction (score ranging from 1–5 with higher values representing higher life satisfaction); depressive symptoms (score ranging from 0–45 with higher values indicating more depressive symptoms).

Regression Analysis

Multiple linear FE regressions were performed after adjusting for time-varying covariates including participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses. The Within R^2 is reported in the regression tables reported in this study. The Within R^2 refers to how much of the variation in the outcomes within individuals is captured by our model. Regarding the following results, the direction of change includes a change from no animal to animal as well as animal to no animal, thus not differentiating whether the change in ownership has occurred through loss or acquisition.

Firstly, regression analysis was performed, with changes in pet ownership being the key time-varying independent variable; results are shown in Table 2. Therefore, the scores of psychosocial variables' measures were compared in individuals before and after they had a change in pet ownership. There was no significant longitudinal association detected between changes in pet ownership and changes in psychosocial outcomes (see Table 2).

Table 2. Pet ownership—results of linear FE regression analysis.

Independent Variables	Depressive Symptoms	Loneliness	Social Isolation	Life Satisfaction
Transition in pet ownership: From not living with pet/s to living with pet/s and vice versa	−0.42	0.03	0.03	−0.04
	(0.30)	(0.02)	(0.03)	(0.03)
Covariates	✓	✓	✓	✓
Observations	12,438	12,332	12,326	12,363
R^2	0.07	0.01	0.01	0.02
Number of individuals	8205	8162	8144	8179

Notes: unstandardized beta-coefficients are displayed; Robust standard errors in parentheses. regressions were performed after adjusting for time-varying covariates. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$.

The transition into pet ownership includes individuals who had no pets in one data collection point but one or more pet/s in the other data collection point. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Further regression analyses were run for changes in dog ownership separately. The results are presented in Table 3. No significant longitudinal associations could be found in this analysis.

Table 3. Dog ownership—results of linear FE regression analysis. (Individuals living with other pets besides dogs excluded).

Independent Variables	Depressive Symptoms	Loneliness	Social Isolation	Life Satisfaction
Transition in dog ownership: From not living with dog/s to living with dog/s and vice versa	−0.72	0.01	0.04	−0.09 +
	(0.67)	(0.04)	(0.06)	(0.05)
Covariates	✓	✓	✓	✓
Observations	10,211	10,122	10,102	10,146
R^2	0.08	0.01	0.01	0.02
Number of individuals	6861	6822	6806	6839

Notes: unstandardized beta-coefficients are displayed; Robust standard errors in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into dog ownership includes individuals who had no dog/s in one data collection point but one or more dog/s in the other data collection point, excluding individuals who lived with other pets than dogs; Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, the level of physical activity, self-rated health, and the number of self-reported illnesses.

However, when the studied group was stratified by gender (see Appendix A, Table A2) there was a significant longitudinal association between having a dog and decreases in life satisfaction for women ($\beta = -0.15$, $p < 0.05$).

The analysis was also run stratified by age group. Results are displayed in the Appendix A, Table A3. There were no significant associations found.

The same regression analyses were performed for cat ownership. The results are displayed in Table 4.

Table 4. Cat ownership—results of linear FE regression analysis. (Individuals living with other pets besides cats are excluded).

Independent Variables	Depressive Symptoms	Loneliness	Social Isolation	Life Satisfaction
Transition in cat ownership: From not owning cat/s to owning cat/s and vice versa	−0.04	0.10 **	0.08 +	−0.07
	(0.50)	(0.03)	(0.05)	(0.05)
Covariates	✓	✓	✓	✓
Observations	10,773	10,671	10,657	10,709
R^2	0.07	0.02	0.01	0.02
Number of individuals	7192	7147	7129	7167

Notes: unstandardized beta-coefficients are displayed; Robust standard errors in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$.

The transition into cat ownership includes individuals who had no cat/s in one data collection point but one or more cat/s in the other data collection point, excluding individuals who lived with other pets than cats. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses. There was a longitudinal association between cat ownership and higher levels of loneliness in the total sample ($\beta = 0.10$, $p < 0.01$).

The analysis was also stratified by gender and age group as shown in Appendix A, Tables A4 and A5. Cat ownership was significantly associated with higher levels of loneliness ($\beta = 0.12$, $p < 0.05$) and higher levels of social isolation ($\beta = 0.13$, $p < 0.05$) for men.

Concerning the stratification by age group, there was no significant longitudinal association found.

In summary, there were few significant associations found and some were only significant for subgroups (e.g., stratified by age or gender).

Results of more linear FE regression analyses can be found in Appendix A (in these analyses, the change in dog ownership includes individuals who own pets other than dogs or have a change in pet ownership besides the necessary change in dog ownership. In the same way, the change in cat ownership includes individuals who own other pets than cats or have a change in pet ownership besides the necessary change in cat ownership).

4. Discussion

4.1. Main Findings

The purpose of this study was to investigate the longitudinal association between pet ownership and psychosocial factors (in terms of depressive symptoms, loneliness, social isolation, and life satisfaction). To this end, longitudinal data were used and linear FE regressions were applied.

FE regressions revealed no significant longitudinal association between any kind of pet ownership over time and changes in depressive symptoms. Cat ownership was significantly associated with higher levels of loneliness among the total sample and men longitudinally. Beyond that, cat ownership was significantly associated with higher levels of social isolation among men. Among women, dog ownership was significantly associated with lower life satisfaction. Our longitudinal study markedly extends the current knowledge regarding the association between pet ownership and psychosocial factors mainly based on cross-sectional studies.

4.2. Possible Explanations and Previous Research

4.2.1. Pet Ownership

There are two studies investigating the longitudinal association between pet ownership over time and changes in depressive symptoms. Batty et al. included 8785 participants with a mean age of 67 and Albright et al. included 1000 older adults with a mean age of 73 [39,40]. Neither study found an association between pet ownership and depressive symptoms. Batty et al. used the CES-D (which was used in our study as well) and Albright et al. used the GDS-15, a well-known tool to quantify depressive symptoms among older adults. Accordingly, the results of longitudinal studies are in line with our results, as we found no association between depressive symptoms and a change in pet ownership as well.

In agreement with our result, Rijken and van Beek found no cross-sectional association between pet ownership and loneliness within a study group consisting of community-dwelling elderly people suffering from chronic illness or disability in a cross-sectional study design with n = 1410 and age $\geq$ 65 [41]. Enmarker et al. also did not find an association between pet ownership and loneliness within their cross-sectional study with 12,093 individuals and a mean age of 75 [13].

The result of our study concerning general pet ownership and life satisfaction aligns with a study by Fraser et al., n = 13,347, measuring life satisfaction using two items adapted from Diener, Emmons, Larsen, and Griffin's (1985) Satisfaction with Life Scale [42]. It also conforms with a study by Le Roux and Wright, n = 3329, using a 5-item satisfaction with life scale [43]. Both studies found no association between pet ownership and life satisfaction. It should be noted that these studies are restricted by using cross-sectional data.

More precisely, given the differences in sample sizes, the tools used to measure psychosocial variables, and the fact that most studies had a cross-sectional design, the differences in the findings seem plausible. While in the introduction the attachment theory was cited as an explanation for a beneficial relationship, it must be said that cohabitating a pet does not equal a strong attachment to the pet. This might serve as an explanation for finding no significant longitudinal associations between changes in pet ownership and psychosocial factors.

4.2.2. Dog Ownership

Our study found no longitudinal association between dog ownership and depressive symptoms. This result is in line with a study by Enmarker et al. with cross-sectional design using the HAD-S (Hospital Anxiety and Depression Scale), a multiple-item depression scale [13].

Our study found that living with a dog was associated with lower life satisfaction among women. The results of existing studies concerning the relationship between dog ownership and life satisfaction are rather contradictory. A recent study with n = 42,687 found dog ownership to be associated with higher life satisfaction [19]. Precisely, single dog ownership was associated with higher life satisfaction when compared to living with multiple dogs or no pets. Meanwhile, a New Zealand study with n = 13,347 [42] and a South African study with n = 3329 [43] found no association with life satisfaction.

Next to key study design differences (all three studies have a cross-sectional design) and different scales being used to assess life satisfaction, differences in cultural backgrounds may contribute to contradictory results. This could be the case since cultural aspects may influence the role of a dog in a family constellation as well as the perceived responsibility for the dog.

The longitudinal association found in our study could be explained by the stress of regularly walking the dog, the increased responsibilities, and the caregiving burden as the pet becomes old or sick [44]. Dog owners may also be limited in activities that involve leaving the house for a longer period of time such as a vacation or even seeing a doctor. For instance, a woman in an interview stated that she does not want to go to the hospital to get her eyesight fixed since she does not want to leave her dog at home by itself [44]. Alternatively, people may turn to their pets to buffer stress and psychological problems

instead of seeing a mental health professional [6]. Additionally, it should be noted that quality of life is not interchangeable with happiness. Happiness corresponds mostly to the subjective part of quality of life whereas the broader term 'quality of life' includes subjective as well as objective aspects [45].

These aspects could explain the correlation between dog ownership and lower life satisfaction and, accordingly, show that the relationship quality may be of great importance for the association. Thus, future qualitative studies are clearly needed.

4.2.3. Cat Ownership

In our study, cat ownership was associated with higher levels of loneliness among the total sample and men in particular, as well as higher levels of social isolation scores among men. This extends prior knowledge, which found that cat owners tended to be more disabled and socially isolated than dog owners based on a qualitative design [44]. In this qualitative study, an elderly woman stated that her cat Missy keeps her up to things [. . .] but if anything happened to her cat she might as well put herself in a nursing home. One may conclude that in an institutionalized setting for people of older age, this woman would be less socially isolated. However, there is conflicting evidence. For example, Hajek and König found no significant difference between cat owners and individuals who did not live with a cat in terms of social isolation [18]. It should be noted that this former cross-sectional study is restricted to individuals without a partner.

Branson et al. as well as Rijken and van Beek found no correlation between cat ownership and loneliness. Branson et al. used the 20-item Revised-UCLA loneliness scale to measure loneliness and Rijken and van Beek used six items of the same scale [41,46]. Differences in results seem plausible as both studies have a cross-sectional design and used a different scale to measure loneliness (our study used the De Jong Gierveld loneliness scale).

Cat ownership is associated with higher loneliness scores and higher social isolation scores (for men) in our study. Wells and Rodi found that caring for a pet may inhibit social interaction as individuals do not want to leave their pet behind, which prevents them from leaving the house in order to socially interact [44]. It may be the case that cat ownership does not enable people to socially interact with others and, as the relationship with a cat may not be very intimate, it contributes to higher loneliness levels. This is supported by Smolkovic et al. who investigated pet attachment using the 15-item Owner–Pet Relationship Scale (OPRS). In this study, female owners were significantly more attached to their pets when compared to male owners; also, cat owners were less attached to their pets when compared to dog owners [32].

5. Conclusions and Future Research

The results of this longitudinal study found the effect of pet ownership on psychosocial variables to be less prominent than initially expected. Also, the direction of association stands in contrast to the hypothesized results as this current study partly found changes to pet ownership to be associated with less favorable psychosocial outcomes. However, it should be noted that such associations were mainly found for certain subgroups (e.g., changes to cat ownership and increases in loneliness; changes to dog ownership and decreases in life satisfaction among women), whereas no associations were found for general pet ownership. Thus, one may conclude that some pets may not be beneficial for certain groups of people. Wells and Rodi found that healthy individuals with good social networks benefit most from pets [44]. This may indicate that individuals who are already prone to psychosocial problems as they have chronic diseases or a dysfunctional social network could be adversely affected by pet ownership.

In conclusion, the results of this longitudinal study call the signs of associations found between pet ownership and psychosocial factors in prior cross-sectional studies into question. The benefits of pet ownership such as companionship, more physical activity through dog ownership, and an increased sense of responsibility may be buffered by the downsides of pet ownership such as the caregiving burden, increased liability, or costs in

time and money. Depending on the characteristics of the pet and its caregiver as well as the relationship between the two, the positive and negative aspects of pet ownership may keep them in balance and thus have no effect on psychosocial factors. Alternatively, as shown in this study, pet ownership may even have a negative effect on certain subgroups.

Nevertheless, positive effects may dominate for individuals who are less affected by the negative aspects of pet ownership. This could be uncovered by restricting the study group to children or interventional strategies such as having pet animals in facility homes or as therapy animals. Through that approach, fewer problems exist with the caregiving burden and responsibility due to staff support [44]. Consequently, the change in pet ownership could be associated with favorable psychosocial outcomes as pet ownership has the potential to boost autonomy, self-esteem, and self-concept in children [47].

With regard to future research, many more studies with longitudinal design are needed in order to confirm our current findings. Additionally, it is important to compare our results to longitudinal studies conducted during the COVID-19 pandemic as these circumstances may affect the effect pet ownership has on psychosocial variables [48]. Moreover, future research should focus on attachment toward the pet, gender characteristics, and differences in the type of pet ownership. In addition, longitudinal research on study groups consisting of children or people in facility homes is necessary. Furthermore, qualitative studies clarifying the motivation to acquire a pet might reveal the reasons for certain associations.

6. Strengths and Limitations

Our longitudinal study adds to the few studies investigating the association between a change in pet ownership and psychosocial variables using a longitudinal approach. This assists in gaining further insights into the directionality. The data for our research come from a large representative sample of people in midlife and older adulthood (DEAS) [25]. Psychosocial outcome measures were quantified using valid and widely used scales and the independent variable pet ownership was further divided into dog and cat ownership. Furthermore, the included sensitivity analysis divided the studied group by gender and age. The study also considered a wide array of covariates. Additionally, using fixed-effects regressions assists in reducing the challenge of unobserved heterogeneity.

One limitation is that the samples focused on community-dwelling individuals and thus excluded individuals living in facility homes. Moreover, due to the modest response rate, a small selection bias exists [25]. Furthermore, the missing data on the number of owned pets as well as death and new acquisition of a pet in between data collection points could lead to undetected psychological findings. For example, a loss or acquisition of a pet in a multi-pet household could stay unobserved.

Additionally, the study's results are based on only two time points of measurement, whereas more points of evaluation could have led to different results. For instance, the health condition of the pet could have changed between 2014 and 2017, leading to an increase in veterinary costs and a time-consuming care burden, thus causing stress for the caregiver. Moreover, some variables such as attachment toward pets, personality traits of owners, and the original motivation to acquire the pet were not taken into consideration—and should be examined in future studies. Furthermore, even though we have considered a wide array of covariates, there are more factors that may influence our results. For instance, children of pet guardians may leave the household in order to go to university, which could result in their parents feeling more lonely and socially isolated.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki. Ethical review and approval were not applicable.

Informed Consent Statement: Patient consent was not applicable.

Data Availability Statement: The data used in this study are third-party data. The anonymized data sets of the DEAS (1996, 2002, 2008, 2011, 2014, 2017, 2020, 2020/2021) are available for secondary analysis. The data has been made available to scientists at universities and research institutes exclusively for scientific purposes. The use of data is subject to written data protection agreements. Microdata of the German Ageing Survey (DEAS) is available free of charge to scientific researchers for non-profitable purposes. The FDZ-DZA provides access and support to scholars interested in using DEAS for their research. However, for reasons of data protection, signing a data distribution contract is required before data can be obtained. Please see for further information (data distribution contract): https://www.dza.de/en/research/fdz/access-to-data/application (accessed on 3 April 2024).

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

Appendix A

Results of Further Regression Analyses

Further linear FE regression analyses were performed for a change in dog ownership, being defined as follows. Individuals who had a change in dog ownership between 2014 and 2017, including individuals who owned other pets besides dogs. Therefore, the included individuals may have a change in cat and/or other pet ownership next to the necessary change in dog ownership. There was no significant longitudinal correlation found for any of the dependent variables. This analysis was also run stratified by gender. There was no significant longitudinal association found for any of the genders. The analysis was also run stratified by age group. The dataset was divided into individuals being younger than 65 years versus individuals being 65 years and above. There was a significant longitudinal association found for social isolation in individuals aged younger than 65. Higher values in social isolation meaning more social isolation were significantly associated with dog ownership ($\beta = 0.12$, $p < 0.05$). Results are displayed in Tables A6–A8.

Moreover, regression analyses were performed for change in cat ownership being defined in the same way: individuals who had a change in cat ownership in between data collection points including individuals who owned other pets and who may even have had a change in pet ownership additionally to the necessary change in cat ownership. The result of the regression analysis conducted a significance for loneliness, indicating that individuals are lonelier when owning a cat compared to when they did not own a cat ($\beta = 0.07$, $p < 0.05$). There was no significant correlation concerning the other variables of interest. The same analysis was then performed, stratified by gender and stratified by age group. Cat ownership was significantly correlated with more social exclusion for men ($\beta = 0.12$, $p < 0.05$). There was no correlation for individuals stratified by age. The results are displayed in Tables A9–A11.

In summary, there were few significant associations found. However, these associations were not consistent across all analyses. The associations differed between cat and dog ownership and most were only significant for subgroups (i.e., stratified by age group or gender).

Table A1. Loss and acquisition of pets between 2014 and 2017.

	Loss of Pet	Acquisition of Pet
Pet ownership	270	158
Dog ownership	60	48
Cat ownership	106	57

Table A2. Dog ownership—results of linear FE regression analysis stratified by gender. (Individuals owning other pets besides dogs excluded).

Gender	Male	Male	Male	Male	Female	Female	Female	Female
Independent Variable	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in dog ownership: From not owning dog/s to owning dog/s and vice versa	−0.44	−0.06	−0.04	−0.01	−0.91	0.06	0.10	−0.15 *
	(1.11)	(0.06)	(0.11)	(0.08)	(0.85)	(0.06)	(0.06)	(0.07)
Covariates	✓	✓	✓	✓	✓	✓	✓	✓
Observations	5166	5127	5114	5139	5045	4995	4988	5007
R^2	0.08	0.02	0.03	0.03	0.09	0.02	0.02	0.03
Number of individuals	3478	3465	3451	3467	3383	3357	3355	3372

Notes: unstandardized beta-coefficients are displayed; Robust standard errors are in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into dog ownership includes individuals who had no dog/s in one data collection point but one or more dog/s in the other data collection point, excluding individuals who owned other pets than dogs. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A3. Dog ownership—results of linear FE regression analysis stratified by age group. (Individuals owning other pets besides dogs excluded).

Age	<65	<65	<65	<65	≥65	≥65	≥65	≥65
Independent Variable	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in dog ownership: From not owning dog/s to owning dog/s and vice versa	0.03	0.05	0.12 +	−0.13 +	−1.37	−0.03	−0.02	−0.05
	(0.90)	(0.05)	(0.07)	(0.07)	(0.99)	(0.07)	(0.10)	(0.09)
Covariates	✓	✓	✓	✓	✓	✓	✓	✓
Observations	4284	4256	4258	4263	5927	5866	5844	5883
R^2	0.10	0.03	0.04	0.04	0.08	0.02	0.02	0.03
Number of individuals	3082	3067	3062	3073	4112	4082	4069	4092

Notes: unstandardized beta-coefficients are displayed; Robust standard errors are in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into dog ownership includes individuals who had no dog/s in one data collection point but one or more dog/s in the other data collection point, excluding individuals who owned other pets than dogs. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A4. Cat ownership—results of linear FE regression analysis stratified by gender. (Individuals owning other pets besides cats excluded).

Gender	Male	Male	Male	Male	Female	Female	Female	Female
Independent Variable	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in cat ownership: From not owning cat/s to owning cat/s and vice versa	−0.40	0.12 *	0.13 *	−0.04	0.23	0.08 +	0.04	−0.11
	(0.69)	(0.05)	(0.06)	(0.08)	(0.74)	(0.05)	(0.06)	(0.07)
Covariates	✓	✓	✓	✓	✓	✓	✓	✓
Observations	5376	5327	5320	5351	5397	5344	5337	5358
R^2	0.06	0.02	0.03	0.03	0.09	0.02	0.02	0.04
Number of individuals	3589	3572	3559	3578	3603	3575	3570	3589

Notes: unstandardized beta-coefficients are displayed; Robust standard errors are in parentheses. ✓ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into cat ownership includes individuals who had no cat/s in one data collection point but one or more cat/s in the other data collection point, excluding individuals who owned other pets than cats. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A5. Cat ownership—results of linear FE regression analysis stratified by age group. (Individuals owning other pets besides cats are excluded).

Age	<65	<65	<65	<65	≥65	≥65	≥65	≥65
Independent Variable	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in cat ownership: From not owning cat/s to owning cat/s and vice versa	−0.62	0.05	0.09	−0.02	0.59	0.09 +	0.10	−0.14 +
	(0.92)	(0.05)	(0.07)	(0.08)	(0.63)	(0.05)	(0.06)	(0.08)
Covariates	✓	✓	✓	✓	✓	✓	✓	✓
Observations	4557	4519	4527	4539	6216	6152	6130	6170
R^2	0.09	0.03	0.04	0.04	0.07	0.02	0.02	0.03
Number of individuals	3265	3242	3241	3258	4293	4263	4247	4269

Notes: unstandardized beta-coefficients are displayed; Robust standard errors are in parentheses. ✓ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into cat ownership includes individuals who had no cat/s in one data collection point but one or more cat/s in the other data collection point, excluding individuals who owned other pets than cats. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A6. Dog ownership—results of linear FE regression analysis. (Individuals owning other pets besides dogs included).

Independent Variables	Depressive Symptoms	Loneliness	Social Isolation	Life Satisfaction
Transition in dog ownership: From not owning dog/s to owning dog/s and vice versa	−0.38	−0.01	0.05	−0.06
	(0.59)	(0.04)	(0.05)	(0.05)
Covariates	✓	✓	✓	✓
Observations	10,749	10,657	10,636	10,680
R^2	0.08	0.01	0.01	0.02
Number of individuals	7200	7160	7143	7176

Notes: unstandardized beta-coefficients are displayed. Robust standard errors are in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into dog ownership includes individuals who had no dog/s in one data collection point but one or more dog/s in the other data collection point, including individuals who own other pets than dogs or have a change in pet ownership besides the necessary change in dog ownership. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A7. Dog ownership—results of linear FE regression analysis stratified by gender. (Individuals owning other pets besides dogs included).

Gender	Male	Male	Male	Male	Female	Female	Female	Female
Independent Variable	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in dog ownership: From not owning dog/s to owning dog/s and vice versa	−0.13	−0.10	−0.00	−0.01	−0.51	0.06	0.10 +	−0.10
	(0.92)	(0.06)	(0.10)	(0.08)	(0.78)	(0.05)	(0.06)	(0.06)
Covariates	✓	✓	✓	✓	✓	✓	✓	✓
Observations	5412	5372	5357	5382	5337	5285	5279	5298
R^2	0.08	0.02	0.03	0.02	0.09	0.02	0.02	0.02
Number of individuals	3631	3618	3602	3619	3569	3542	3541	3557

Notes: unstandardized beta-coefficients are displayed. Robust standard errors are in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into dog ownership includes individuals who had no dog/s in one data collection point but one or more dog/s in the other data collection point, including individuals who own other pets than dogs or have a change in pet ownership besides the necessary change in dog ownership. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A8. Dog ownership—results of linear FE regression analysis stratified by age group. (Individuals owning other pets besides dogs included).

Age	**<65**	**<65**	**<65**	**<65**	**≥65**	**≥65**	**≥65**	**≥65**
Independent Variable	**Depressive Symptoms**	**loneliness**	**Social Isolation**	**Life Satisfaction**	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in dog ownership: From not owning dog/s to owning dog/s and vice versa	0.01	0.01	0.12 *	−0.08	−0.66	−0.05	−0.02	−0.05
	(0.79)	(0.05)	(0.06)	(0.07)	(0.91)	(0.07)	(0.09)	(0.08)
Covariates	✓	✓	✓	✓	✓	✓	✓	✓
Observations	4668	4639	4639	4647	6081	6018	5997	6033
R^2	0.09	0.03	0.04	0.04	0.08	0.02	0.02	0.03
Number of individuals	3338	3322	3316	3329	4212	4182	4169	4190

Notes: unstandardized beta-coefficients are displayed. Robust standard errors are in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into dog ownership includes individuals who had no dog/s in one data collection point but one or more dog/s in the other data collection point, including individuals who own other pets than dogs or have a change in pet ownership besides the necessary change in dog ownership. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A9. Cat ownership—results of linear FE regression analysis. (Individuals owning other pets besides cats included).

Independent Variables	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in cat ownership: From not owning cat/s to owning cat/s and vice versa	−0.03	0.07 *	0.06	−0.04
	(0.46)	(0.03)	(0.04)	(0.05)
Covariates	✓	✓	✓	✓
Observations	11,407	11,303	11,285	11,339
R^2	0.07	0.01	0.01	0.02
Number of individuals	7578	7535	7513	7552

Notes: unstandardized beta-coefficients are displayed. Robust standard errors are in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into cat ownership includes individuals who had no cat/s in one data collection point but one or more cat/s in the other data collection point, including individuals who own other pets than cats or have a change in pet ownership besides the necessary change in cat ownership. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A10. Cat ownership—results of linear FE regression analysis stratified by gender. (Individuals owning other pets besides cats included).

Gender	Male	Male	Male	Male	Female	Female	Female	Female
Independent Variable	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in cat ownership: From not owning cat/s to owning cat/s and vice versa	−0.65	0.08	0.12 *	−0.01	0.48	0.07	0.01	−0.07
	(0.62)	(0.05)	(0.06)	(0.07)	(0.67)	(0.04)	(0.06)	(0.06)
Covariates	✓	✓	✓	✓	✓	✓	✓	✓
Observations	5665	5615	5604	5638	5742	5688	5681	5701
R^2	0.07	0.02	0.03	0.02	0.09	0.02	0.01	0.04
Number of individuals	3761	3745	3728	3750	3817	3790	3785	3802

Notes: unstandardized beta-coefficients are displayed. Robust standard errors are in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into cat ownership includes individuals who had no cat/s in one data collection point but one or more cat/s in the other data collection point, including individuals who own other pets than cats or have a change in pet ownership besides the necessary change in cat ownership. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

Table A11. Cat ownership—results of linear FE regression analysis stratified by age group. (Individuals owning other pets besides cats included).

Age	<65	<65	<65	<65	≥65	≥65	≥65	≥65
Independent Variable	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**	**Depressive Symptoms**	**Loneliness**	**Social Isolation**	**Life Satisfaction**
Transition in cat ownership: From not owning cat/s to owning cat/s and vice versa	−0.47	0.02	0.09	0.03	0.39	0.06	0.06	−0.11
	(0.80)	(0.05)	(0.06)	(0.07)	(0.60)	(0.05)	(0.06)	(0.07)
Covariates	✓	✓	✓	✓	✓	✓	✓	✓
Observations	4990	4951	4957	4972	6417	6352	6328	6367
R^2	0.09	0.03	0.04	0.04	0.07	0.02	0.02	0.03
Number of individuals	3553	3529	3527	3546	4414	4387	4368	4389

Notes: unstandardized beta-coefficients are displayed. Robust standard errors are in parentheses. √ = regressions were performed after adjusting for time-varying covariates. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Transition into cat ownership includes individuals who had no cat/s in one data collection point but one or more cat/s in the other data collection point, including individuals who own other pets than cats or have a change in pet ownership besides the necessary change in cat ownership. Covariates include participants' age, marital status, household income, employment status, smoking behavior, alcohol intake, level of physical activity, self-rated health, and the number of self-reported illnesses.

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